



## FCC RADIO TEST REPORT

Applicant's company	<b>Broadcom Corporation</b>
Applicant Address	190 Mathilda Place Sunnyvale CA 94086 U.S.A.
FCC ID	<b>QDS-BRCM1075</b>
Manufacturer's company	<b>Broadcom Corporation</b>
Manufacturer Address	190 Mathilda Place Sunnyvale CA 94086 U.S.A.

Product Name	Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth 4.0 NGFF2230 Mini Card
Brand Name	Broadcom
Model Name	BCM943162ZP
Test Rule	47 CFR FCC Part 15 Subpart C § 15.247
Test Freq. Range	2402 ~ 2480MHz
Received Date	Dec. 25, 2013
Final Test Date	Apr. 18, 2014
Submission Type	Class II Change

### Statement

**Test result included is only for the Bluetooth BR/EDR part of the product.**

The test result in this report refers exclusively to the presented test model / sample.

Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in **ANSI C63.4-2003** and **47 CFR FCC Part 15 Subpart C**.

The test equipment used to perform the test is calibrated and traceable to NML/ROC.



## Table of Contents

<b>1. CERTIFICATE OF COMPLIANCE .....</b>	<b>1</b>
<b>2. SUMMARY OF THE TEST RESULT .....</b>	<b>2</b>
<b>3. GENERAL INFORMATION .....</b>	<b>3</b>
3.1. Product Details.....	3
3.2. Accessories.....	3
3.3. Table for Filed Antenna.....	4
3.4. Table for Carrier Frequencies .....	5
3.5. Table for Test Modes.....	5
3.6. Table for Testing Locations.....	6
3.7. Table for Supporting Units .....	6
3.8. Table for Class II Change .....	6
3.9. Test Configurations .....	7
<b>4. TEST RESULT .....</b>	<b>8</b>
4.1. Radiated Emissions Measurement.....	8
4.2. Antenna Requirements .....	14
<b>5. LIST OF MEASURING EQUIPMENTS .....</b>	<b>15</b>
<b>6. MEASUREMENT UNCERTAINTY.....</b>	<b>16</b>
<b>APPENDIX A. TEST PHOTOS .....</b>	<b>A1 ~ A4</b>



## History of This Test Report



## 1. CERTIFICATE OF COMPLIANCE

Product Name : Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth 4.0 NGFF2230 Mini Card  
Brand Name : Broadcom  
Model No. : BCM943162ZP  
Applicant : Broadcom Corporation  
Test Rule Part(s) : 47 CFR FCC Part 15 Subpart C § 15.247

Sportun International as requested by the applicant to evaluate the EMC performance of the product sample received on Dec. 25, 2013 would like to declare that the tested sample has been evaluated and found to be in compliance with the tested rule parts. The data recorded as well as the test configuration specified is true and accurate for showing the sample's EMC nature.

A handwritten signature in blue ink that reads "Sam Chen".

Sam Chen

SPORTON INTERNATIONAL INC.

## 2. SUMMARY OF THE TEST RESULT

Applied Standard: 47 CFR FCC Part 15 Subpart C				
Part	Rule Section	Description of Test	Result	Under Limit
4.1	15.247(d)	Radiated Emissions	Complies	3.06 dB
4.2	15.203	Antenna Requirements	Complies	-

### 3. GENERAL INFORMATION

#### 3.1. Product Details

Items	Description
Power Type	From host system
Modulation	FHSS (GFSK / $\pi/4$ -DQPSK / 8DPSK)
Data Rate (Mbps)	GFSK: 1 ; $\pi/4$ -DQPSK: 2 ; 8DPSK: 3
Frequency Range	2402 ~ 2480MHz
Channel Number	79
Carrier Frequencies	Please refer to section 3.4
Antenna	Please refer to section 3.3
Note 1: Bluetooth BR uses a combination of GFSK (1Mbps).	
Note 2: Bluetooth EDR uses a combination of $\pi/4$ -DQPSK (2Mbps) and 8DPSK (3Mbps).	

#### 3.2. Accessories

N/A

### 3.3. Table for Filed Antenna

Set	Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)				
						2.4GHz	5GHz B1	5GHz B2	5GHz B3	5GHz B4
1	1	MAG.LAYERS	PCA-4077-25GC1-A1	WLAN/BT antenna	IPEX A13	3.33	5.85	5.85	6.21	6.21
	2	MAG.LAYERS	PCA-4077-25GC1-A1	WLAN/BT antenna	IPEX A13	3.33	5.85	5.85	6.21	6.21

Note1: The each set has two antennas.

**For 2.4GHz:**

**For IEEE 802.11b/g/n mode (1TX/1RX)**

The EUT supports the antenna with TX/RX diversity function.

Both Chain 1 and Chain 2 can be used as transmitting/receiving antenna, but only one antenna can be used as transmitting/receiving antenna at the same time.

Chain 1 generated the worst case than Chain 2, so it tested and recorded in the report.

**For 5GHz:**

**For IEEE 802.11a/n/ac mode (1TX/1RX)**

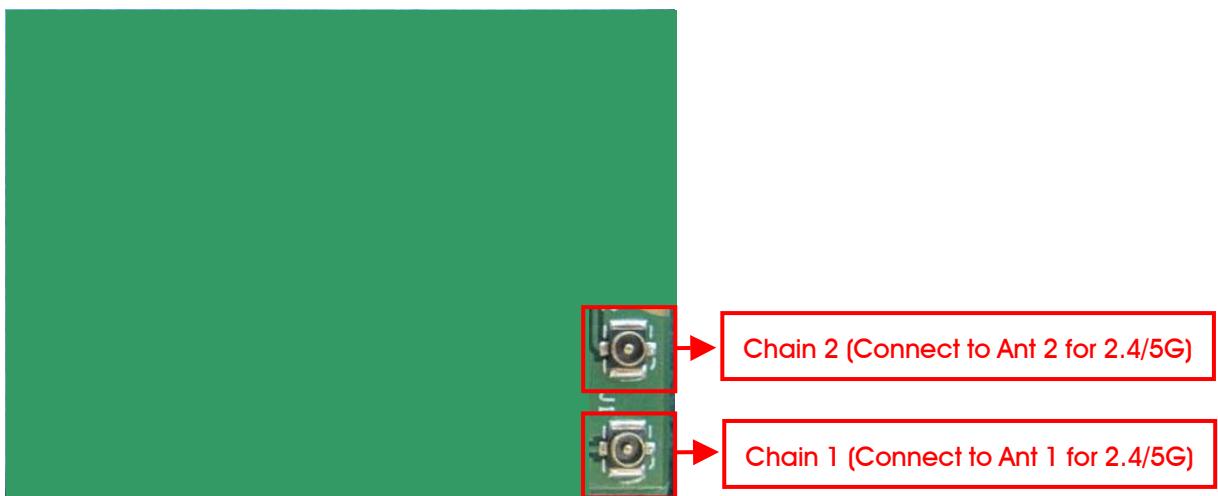
The EUT supports the antenna with TX/RX diversity function.

Both Chain 1 and Chain 2 can be used as transmitting/receiving antenna, but only one antenna can be used as transmitting/receiving antenna at the same time.

Chain 1 generated the worst case than Chain 2, so it tested and recorded in the report.

**For Bluetooth mode (1TX/1RX)**

Only Chain 1 can be used as transmitting/receiving antenna.



### 3.4. Table for Carrier Frequencies

Frequency Band	Channel No.	Frequency	Channel No.	Frequency
2400~2483.5MHz	0	2402 MHz	40	2442 MHz
	1	2403 MHz	:	:
	:	:	77	2479 MHz
	38	2440 MHz	78	2480 MHz
	39	2441 MHz	-	-

### 3.5. Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate	Channel	Chain
Radiated Emissions Below 1GHz	Normal Link	-	-	-

The following test modes were performed for all tests:

**For Radiated Emission Below 1GHz test:**

Mode 1. Normal Link -2.4GHz WLAN function + Bluetooth function

Mode 2. Normal Link -5GHz WLAN function + Bluetooth function

Mode 2 is the worst case, so it was selected to record in this test report.

### 3.6. Table for Testing Locations

Test Site Location					
Test Site No.	Site Category	Location	FCC Reg. No.	IC File No.	VCCI Reg. No
03CH01-CB	SAC	Hsin Chu	262045	IC 4086D	-

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC).

### 3.7. Table for Supporting Units

For Test Site No: 03CH01-CB (Below 1GHz)

Support Unit	Brand	Model	FCC ID
Wireless AP	Planex	GW-AP54SGX	N/A
NB	DELL	E6220	DoC
NB	DELL	E6430	DoC
Mouse	Logitech	M-U0026	DoC
Earphone	SHYARO CHI	MIC-04	N/A
Test fixture*2	Broadcom	BCM9NGFF2EC_1	N/A
Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth 4.0 NGFF2230 Mini Card (Device)	Broadcom	BCM943162ZP	QDS-BRCM1075

### 3.8. Table for Class II Change

This product is an extension of original one reported under Sporton project number: FR3D2546AC

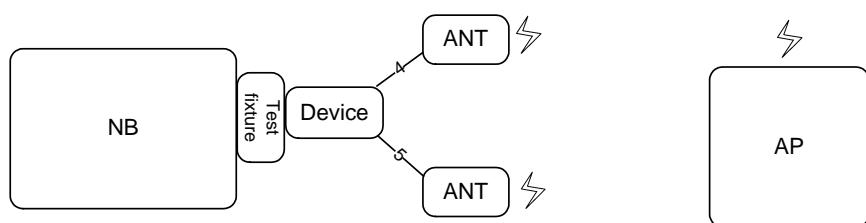
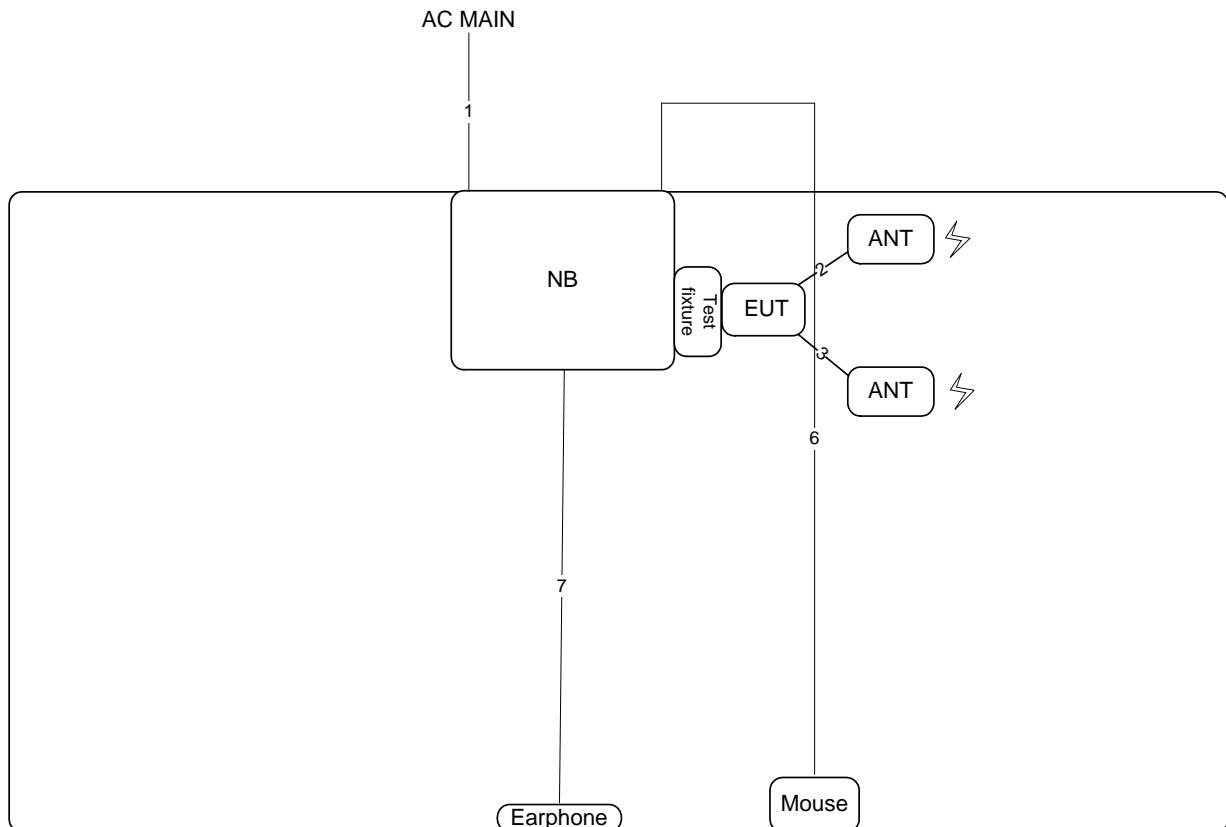
Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
<ol style="list-style-type: none"> <li>Adding a new antenna (Brand: MAG. LAYERS, Model No.: PCA-4077-25GC1-A1) for this device.</li> <li>The application of this module increases to portable host equipment. The module is limited to use the new antenna (Brand: MAG. LAYERS, Model No.: PCA-4077-25GC1-A1) when it is defined as portable device.</li> </ol>	Radiated Emissions Below 1GHz

Note: New antenna and original antenna are the same type, but the gain of new antenna is higher than the original one in 5GHz. Thus, we checked the test items above.

### 3.9. Test Configurations

#### 3.9.1. Radiation Emissions Below 1GHz Test Configuration



Item	Connection	Shielded	Length
1	Power cable	No	2.6m
2	ANT cable	Yes	0.2m
3	ANT cable	Yes	0.2m
4	ANT cable	Yes	0.2m
5	ANT cable	Yes	0.2m
6	USB cable	Yes	1.8m
7	Audio cable	No	1.1m

## 4. TEST RESULT

### 4.1. Radiated Emissions Measurement

#### 4.1.1. Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolt/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

#### 4.1.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RBW / VBW (Emission in restricted band)	1MHz / 3MHz for Peak, 1MHz / 10Hz for Average
RBW / VBW (Emission in non-restricted band)	100kHz / 300kHz for peak

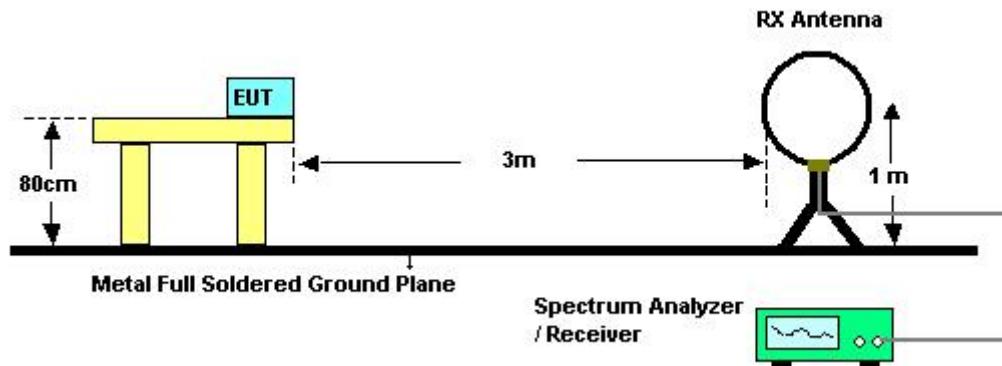
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RBW 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RBW 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RBW 120kHz for QP

#### 4.1.3. Test Procedures

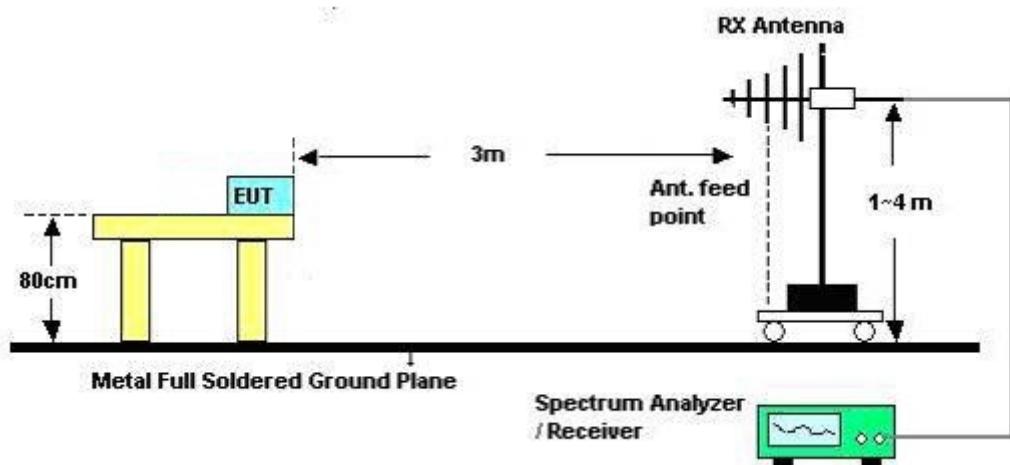
1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and 3MHz RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High – Low scan is not required in this case.

#### 4.1.4. Test Setup Layout

For Radiated Emissions: 9kHz ~30MHz



For Radiated Emissions: 30MHz~1GHz



#### 4.1.5. Test Deviation

There is no deviation with the original standard.

#### 4.1.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

#### 4.1.7. Results of Radiated Emissions (9kHz~30MHz)

Temperature	21°C	Humidity	61%
Test Engineer	YC Chen	Test Date	Apr. 18, 2014
Configurations	Normal Link	Test Mode	Mode 2

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Limit Line (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

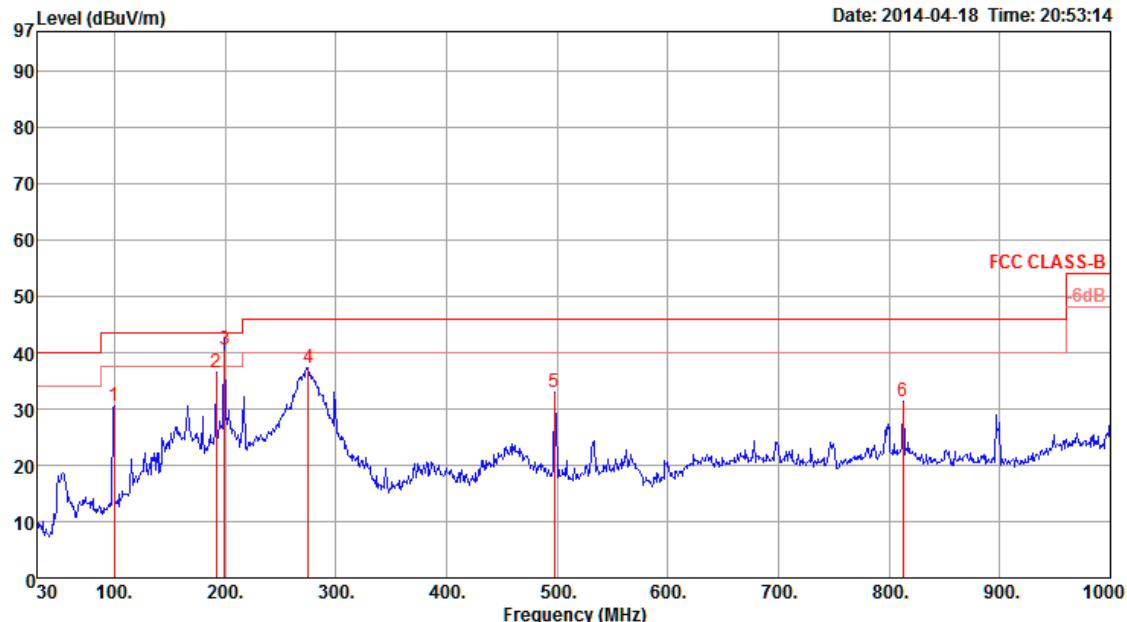
Distance extrapolation factor =  $40 \log (\text{specific distance} / \text{test distance})$  (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

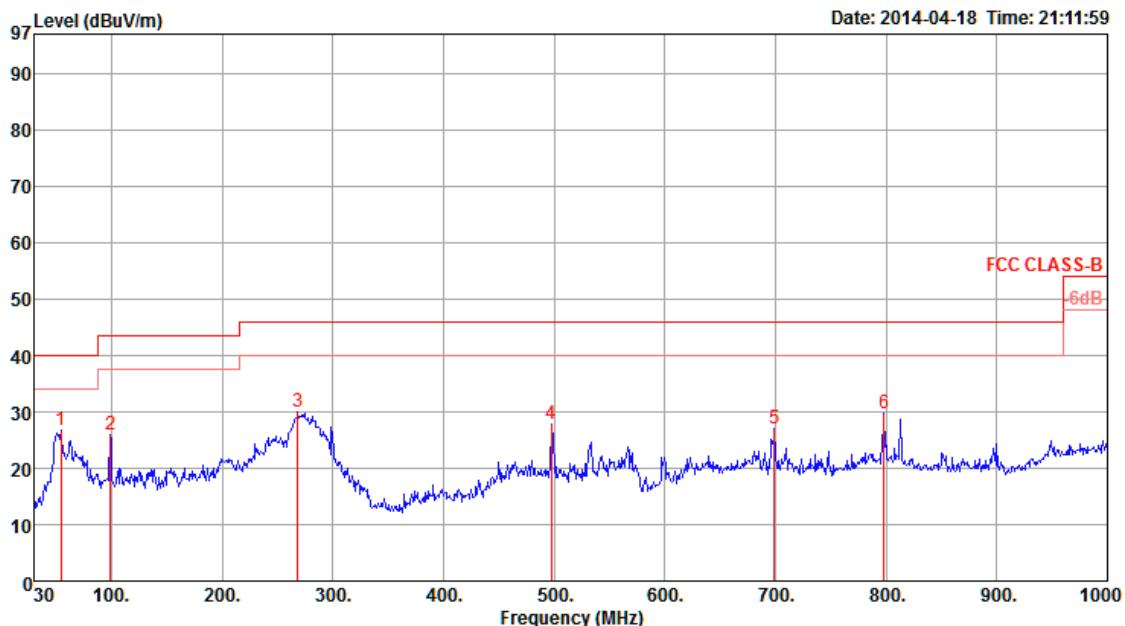
#### 4.1.8. Results of Radiated Emissions (30MHz~1GHz)

Temperature	21°C	Humidity	61%
Test Engineer	YC Chen	Configurations	Normal Link
Test Mode	Mode 2		

##### Horizontal



Freq	Level	Limit	Over	Read	Cable			Preamp	T/Pos	A/Pos	Pol/Phase
					Line	Limit	Level				
1	99.84	30.41	43.50	-13.09	52.27	1.50	11.40	27.82	Peak	0	100 HORIZONTAL
2	191.99	36.38	43.50	-7.12	56.24	2.06	10.08	27.30	Peak	0	100 HORIZONTAL
3	199.75	40.44	43.50	-3.06	58.70	2.09	10.40	27.25	QP	252	100 HORIZONTAL
4	275.41	37.35	46.00	-8.65	54.11	2.51	13.85	26.89	Peak	0	100 HORIZONTAL
5	497.54	33.04	46.00	-12.96	46.84	3.37	17.76	27.93	Peak	0	100 HORIZONTAL
6	812.79	31.35	46.00	-14.65	39.21	4.38	21.30	26.89	Peak	0	100 HORIZONTAL

**Vertical**


Freq MHz	Level dBuV/m	Limit Line dBuV/m	Over Limit dB	Read Level dBuV	Cable Loss Factor			Antenna Factor	Preamp Factor	Remark	T/Pos deg	A/Pos cm	Pol/Phase
1 54.25	26.71	40.00	-13.29	52.39	1.12	8.00	27.90	Peak	360	400	VERTICAL		
2 98.87	25.84	43.50	-17.66	47.93	1.49	11.20	27.82	Peak	360	400	VERTICAL		
3 268.62	30.07	46.00	-15.93	47.03	2.48	13.91	26.90	Peak	360	400	VERTICAL		
4 497.54	27.74	46.00	-18.26	41.54	3.37	17.76	27.93	Peak	360	400	VERTICAL		
5 699.30	26.99	46.00	-19.01	36.94	4.16	19.90	27.09	Peak	360	400	VERTICAL		
6 798.24	29.85	46.00	-16.15	37.42	4.35	21.18	26.90	Peak	360	400	VERTICAL		

**Note:**

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

## 4.2. Antenna Requirements

### 4.2.1. Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

### 4.2.2. Antenna Connector Construction

Please refer to section 3.3 in this test report, antenna connector complied with the requirements.

## 5. LIST OF MEASURING EQUIPMENTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
BILOG ANTENNA	Schaffner	CBL6112D	2888	20MHz ~ 2GHz	Jan. 15, 2014	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9 kHz - 30 MHz	Nov. 05, 2012*	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8447D	2944A10991	0.1MHz ~ 1.3GHz	Nov. 12, 2013	Radiation (03CH01-CB)
Spectrum analyzer	R&S	FSP40	100019	9kHz~40GHz	Dec. 02, 2013	Radiation (03CH01-CB)
EMI Test Receiver	Agilent	N9038A	MY52260123	9kHz ~ 8GHz	Dec. 12, 2013	Radiation (03CH01-CB)
Turn Table	INN CO	CO 2000	N/A	0 ~ 360 degree	N.C.R.	Radiation (03CH01-CB)
Antenna Mast	INN CO	CO 2000	N/A	1 m - 4 m	N.C.R.	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-1	N/A	30 MHz - 1 GHz	Nov. 17, 2013	Radiation (03CH01-CB)

Note: Calibration Interval of instruments listed above is one year.

“\*” Calibration Interval of instruments listed above is two years.

N.C.R. means Non-Calibration required.

## 6. MEASUREMENT UNCERTAINTY

### Uncertainty of Radiated Emission Measurement (30MHz ~ 1,000MHz)

Contribution	Uncertainty of $x_i$			$u(x_i)$
	Value	Unit	Probability Distribution k	
Receiver reading	$\pm 0.173$	dB	K=1	0.086
Cable loss	$\pm 0.174$	dB	K=2	0.087
Antenna gain	$\pm 0.169$	dB	K=2	0.084
Site imperfection	$\pm 0.433$	dB	Triangular	0.214
Pre-amplifier gain	$\pm 0.366$	dB	K=2	0.183
Transmitter antenna	$\pm 1.200$	dB	Rectangular	0.600
Signal generator	$\pm 0.461$	dB	Rectangular	0.231
Mismatch	$\pm 0.080$	dB	U-shape	0.040
Spectrum analyzer	$\pm 0.500$	dB	Rectangular	0.250
Combined standard uncertainty $U_c(y)$				1.778
Measuring uncertainty for a level of confidence of 95% $U=2U_c(y)$				3.555